

selected from Mo, W, V, Nb, Sb, Sn, Pt, Pd, Cs, Zr, Cr, Mg, Mn, Ni, Co, Ce, or a mixture of two or more thereof.

29. The apparatus of claim 1 wherein the catalyst comprises: a noble metal, a transition metal or combination thereof; an oxide of an alkali metal, alkaline earth metal, boron, gallium, germanium, arsenic, selenium, tellurium, thallium, lead, bismuth, polonium, magnesium, titanium, vanadium, chromium, manganese, iron, nickel, cobalt, copper, zinc, zirconium, molybdenum, tin, calcium, aluminum, silicon, lanthanum series element; or a combination of any two or more of the foregoing.

30. The apparatus of claim 1 wherein the sorption medium comprises silver, gold, platinum, palladium, nickel, zeolite, silica gel, or a combination of two or more thereof.

31. The apparatus of claim 1 wherein the sorption medium is derived from Fe(II), Co(II), Cu(I), V(II), Mn(II), Mn(III), Cr(II), Ag(I), Rh(I), Rh(II), Rh(III), U(IV), V(IV), Ru(II), Ru(IV), Ti(III), Cr(IV), Bi(III), Ni(II), W(V), W(IV), Mo(II), Mo(III), Mo(IV), Mo(V), Mo(VI), or a combination of two or more thereof.

32. The apparatus of claim 1 wherein the sorption medium is derived from: dipyridyl; 2,6-[1-(2-imidazol-4-ylethylimino)ethyl pyridine]; cyclen; cyclam; a Schiff base ligand; acetyl acetone or an oligomer or polymer thereof; a carboxylate; bipyridyl or an oligomer or polymer thereof; a porphyrin or an oligomer or polymer thereof; a corin or an oligomer or polymer thereof; a polyamide; a protein; 8-hydroxy quinoline or an oligomer or polymer thereof; ethyl cysteinate or an oligomer or polymer thereof; an N-alkyl alkanohydroxamic acid; dimethylglyoxime; sym-diethylethylenediamine; or a combination of two or more thereof.

33. The apparatus of claim 1 wherein the sorption medium is derived from an imidazole, histidine amino acid, pyridine, piperidine, 4-methyl aminopyridine, 4-dimethyl aminopyridine, a nitrate, a thiocyanate, a halide, or a combination of two or more thereof.

34. The apparatus of claim 1 wherein the sorption medium comprises: hemoglobin; hemoerythrin; hemocyanin; myoglobin; Co(II) (acacen); Co(II) (dry cave) (N-methyl imidazole); Fe(II) (H₂TpivPP)B; Fe(II)(capped porphyrin)B; Fe(ophen)₂²⁺; bis(ethyl cysteinate) oxovanadium (IV); Cu(I) (bimp); bis(dimethylglyoximato)cobalt(II); bis(histidine)cobalt(II); dinitrato-bis(sym-diethylethylenediamine)cobalt(II); dichloro-bis(sym-diethylethylenediamine)cobalt(II); [m-tetra(a,a,a,a-o-pivalamidophenyl)porphyrin] cobalt(II); [N,N'-bis(salicylidene)dipropylenetriamine] cobalt(II); [2,3,10,11,13,19-hexamethyl-3,10,14,18,21,25-hexaazabicyclo[10.7.7]hexacos-1,11,13,18,20,25-hexene-k⁴N)cobalt(II)hexafluorophosphate; [N,N'-bis(salicylicylidene)ethylenediamine]cobalt(I); [N,N'-bis(3-methoxysalicylicylidene)ethylenediamine]cobalt(II); [N,N'-bis(salicylicylidene)tetramethylethylenediamine]cobalt(II); [N,N'-bis(3-methoxysalicylicylidene)tetramethylethylenediamine]cobalt(II); [N,N'-bis(3-ethoxysalicylicylidene)tetramethylethylenediamine]cobalt(II); [N,N'-bis(5-n-butoxysalicylicylidene)tetramethylethylenediamine]cobalt(II); [N,N'-bis(salicylidene)ethylenediamine]

cobalt(II)); a cobalt (II) porphyrin complex; a metal-cyanide complex encapsulated within a zeolite; a cyanocobaltate; hemoglobin, hemerythrin or hemocyanin containing a diiron(III,IV), dicopper(II) or dimanganese core; N,N'-disalicylideneethylenediamine cobalt(II); cobalt di-(3-methoxysalicylal tertbutylamine); [N,N'-bis(salicylidene)n-propylidipropylenetriamine]cobalt(II); 1-methylimidazole; 2-methylimidazole; 4-dimethylaminopyridine; cyanopyridine; cobalt chelated copolymer derived from ethylenediamine-tetraacetic acid, methyl methacrylate and butyl acrylate; bis(histidine) cobalt(II); [a-mono(o-methacrylamidophenyl)-a,a-tris(o-pivalamidophenyl)porphinato]cobalt; [meso-a,a,a,a-tetrakis(o-pivalamidophenyl)porphinato]-iron(II); cobalt(II) meso-tetra-phenyl-porphyrin; cobalt(II) meso-tetrakis(2-chlorophenyl)prophyrin; cobalt(II) meso-tetrakis(4-chlorophenyl)porphyrin; cobalt(II) meso-tetrakis(4-methoxy phenyl) porphyrin; cobalt(II) meso-tetrakis(2,4-dimethoxy phenyl)porphyrin; ruthenium (III) bis(salicylaldehyde)ethylenediiimine; ruthenium (III) bis(salicylaldehyde)diethlenetriimine; ruthenium (III) bis(picolinaldehyde)-o-phenylenediimine; ruthenium (III) bis(picolinaldehyde)ethylenediiimine; ruthenium (III) bis(picolinaldehyde)diethylenetriimine; bis(dimethylglyoximato)nickel(II); bis(dimethylglyoximato)cobalt(II); bis(dimethylglyoximato)copper(II); dinitrato-bis(sym-diethylethylenediamine)cobalt(II); dithiocyanato-bis(sym-diethylethylenediamine)cobalt(II); dichloro-bis(sym-diethylethylenediamine)cobalt(II); cobalt di-(salicylal)-3,3'-diimino-di-n-propylamine; N,N'-disalicyclidene ethylene diamine cobalt (II); N,N'-ethylene-bis(5-nitro-salicylideneimato) cobalt(II), or a combination of two or more thereof.

35. The apparatus of claim 1 wherein the sorption medium comprises Sb₂O₅, AgO, PtO, CrO₂, PbO, HgO, Cu₂O, MnO, Mn₂O₃, Bi₂O₄, NiO, NiO₂, Cu₂O₃, SnO, SnO₂, WO₂, WO₃, W₂O₅, perfluorinated film, Pt/g-alumina, Fe/g-alumina, Cu/g-alumina, Zn/g-alumina, Co/g-alumina, zeolite, or a combination of two or more thereof.

36. The apparatus of claim 1 wherein the sorption medium comprises a metal cyanide oligomer or polymer.

37. The apparatus of claim 36 wherein the metal cyanide oligomer or polymer is represented by the formula [Cu(I)(CN)_x]_n, [Fe(ii)(CN)_y]_n or [Co(II)(CN)_y]_n, wherein x is 3, y is 5 and n is a number that is at least 2.

38. The apparatus of claim 1 wherein the sorption medium comprises silica gel, foamed coppper, sintered stainless steel fiber, alumina, poly(methyl methacrylate), polysulfonate, poly(tetrafluoroethylene), iron, nickel sponge, nylon, polyvinylidene fluoride, polypropylene, polyethylene, polyethylene ethylketone, polyvinyl alcohol, polyvinyl acetate, polyacrylate, polymethylmethacrylate, polystyrene, polyphenylene sulfide, polysulfone, polybutylene, or a combination of two or more thereof.

39. The apparatus of claim 1 wherein the sorption comprises a secondary amine, phenolic phosphate, phosphite, phenolic, bisphenolic, hydroxylamine, olefinic carboxylate, amino carboxylate, tocopherol, di-tertiarybutyl-p-cresol, stannous salt, stannous oxide, sorbate, polysorbate, or a combination of two or more thereof.

40. The apparatus of claim 1 wherein the sorption medium comprises a deposit derived from methane and hydrogen.